



CrossChasm Fleet-Wide CANbus Data Logging

User Manual

CrossChasm C5 Fleet
CAN Logger

Vehicle Development Tools



Product Description:

CrossChasm's C5 Vehicle Data Management system provides low volume vehicle development teams a process to monitor and manage a set of deployed vehicles in the field. Existing vehicle telematics systems are either designed exclusively for AVL and/or OBD2, or alternatively can simply log and dump all data back to the engineering team.

The C5 system provides both hardware and cloud-based software to provide both conventional fleet usage tracking as well as providing generalized CAN-based logging. The system also provides vehicle usage data in such a way to allow diagnostic team to quickly dig into specific events and only retrieve the detailed datalogs from that particular period of time. All datalogs are backed up through the FleetCarma.com portal hosted on Microsoft's Windows Azure Cloud Platform.

The in-vehicle hardware can be fully configured over-the-air and can be installed (with appropriate harness) into any heavy or light duty vehicle using one or two CANbuses. The system comes with Cellular, GPS, Wifi optional add-ons. It can be configured to either log frames at a specific rate, or to log frames continuously, as well as transmit both fixed frame messages and response messages. The logger will sleep to reduce power consumption to less than 1mA, and can wake-up on either CAN traffic or vehicle voltage thresholds.

Configuring a C5 logger is simple. The Logging Configuration PC Application allows the engineering team to select the desired CAN frames and rates to be logged. If a range of CAN ID's should be logged, this can be accomplished with one of four CAN Masks. If data queries are required, these can be added at this time as well, such that the C5 can query information from a controller. If you would like the C5 to transmit a frame in response to a particular set of payload data on a particular ID frame, this is also possible.

Viewing a single set of data from a vehicle is simple. The SD card may be loaded into a PC and the raw data can be decoded into either .CSV files for access via Excel, Matlab, etc, or into .ASC CAN data files for access via CANalyzer or other Vector Software. This is done using the C5 Decoder Software

Alternatively, the data may be manually uploaded into FleetCarma.com for permanent storage and to provide vehicle usage and performance reports. This reporting framework makes it easy to identify potential issues, off-nominal conditions, abnormal vehicle usage, etc, that may be useful for diagnostic



and monitoring of the vehicle. Using the C5's Cellular option or the Wifi option removes the need to access data manually, and instead data will automatically get stored in the FleetCarma website for retrieval as desired.

C5 Hardware Specifications

Voltage Specifications

		Units
Absolute Maximum Voltage	30	V
Absolute Minimum Voltage	8.0	V
Minimum Configurable Wake Voltage	8.0	V
Maximum Configurable Wake Voltage	30	V
Minimum Configurable Sleep Voltage	8.0	V
Maximum Configurable Sleep Voltage	30	V
Require Always on Voltage?	No ¹	
CANbus Sleep waiting period	20	Sec

¹ Wireless communication requires always on power since the logger uploads logged data only when the sleep mode is activated.

CANbus Specifications

		Units
Number of CANbus Channels	2	
CANBus Baud Rates	125k,250k,500k,1M	
Maximum Log rate/Channel	~2000	Mess/Sec
Fixed Frame Transmit Maximum Rate	20	Milliseconds
Maximum number of unique Fixed Frame transmit frames/Channel	25	
Maximum number of unique loggable frames/Channel	None	
Maximum loggable rate limit per signal	None	
Minimum single frame rate limit	10	Minutes
Maximum number of filter masks/channel	4	
Maximum number of pattern-matched echoed transmits	25	

Storage Specifications

		Units
Storage Media Type	Micro-SD Card	
SD Card Maximum Size	None ²	
File Format Spec	FAT	
File Format Power/Corruption Protection System	SAFE-FAT	
Logged format	Binary .bin	
CAN Logging Configuration Format	Binary .ccf	
Wireless Configuration Format	Binary .ccw	
Logger Status Diagnostics File	Ascii clear text .ccl	

SD Card recommended supplier	SwissBit ²	
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² The possibility of corruption exists on most SD card when power is interrupted. The C5 protects against this via two methods: SAFE-FAT transactional redundancy at the file system layer, and the use of SwissBit® micro-SD cards. Use of alternative SD cards is possible, but not recommended. The C5 will always be provided with a Swissbit 512MB SD card.

Wifi Specifications

		Units
Network Standard	IEEE 802.11 b/g	
Wifi Security Types	WEP / WPA / WPA2 / EAP	
Output Power	+12	dBm
Typical Range	300	Ft line of sight
Antenna Type	External Windshield Mount	
Access URL/Server	www.fleetcarma.com	
Port Access	80	
Certification	FCC/IC/CE	

Cellular (GSM) Specifications

		Units
External Modem Dimensions	2.6" x 3.75" 1.2"	
SIM type	Standard Mini SIM, user replaceable	
Antennas	Leaded dashboard mount integrated GPS/GSM	
Approvals	FCC/CE/AT&T/T-Mobile/Rogers	
Power	C5 supplied via Tether	

Special Notes and Limitations

The C5 and its SD card are not compatible with Apple computers due to an interaction between the file management layer in Apple and the Safe-FAT system the C5 uses to protect the integrity of the file system. To ensure the integrity of the file system on the SD card, only use Windows PC's to interact with the SD card.

It is also recommended that when the SD card is placed into a Windows computer, the card is properly ejected before physical removal from the PC.

Before removing the SD card from the logger, ensure the logger is fully powered down (unplugged from the vehicle).

First Timer Start-up Guide:

The comprehensive process to get the wireless logger fully functional follows. Note that this procedure is important to use the very first time you set up your logger for integration between your vehicle and FleetCarma. Once the key steps have been established, adding additional loggers is a straightforward task.

Log Data:

- 1) Set up the logger locally using your PC and confirm data is being logged and decoded properly using the **Logger Configuration Builder** and the **Log File Decoder** PC applications. Use the Logger Configuration Builder to generate the .CCF file (Logging Configuration), and place it on the root directory of the SD card. Observe that no Red lights are seen. Refer to the LED color chart for status information. Log files will appear, numbered sequentially in the LOGS directory.

Create your vehicle and link your C5:

- 1) Click on the Vehicles tab, and Add New Vehicle. If your vehicle is not listed in the drop down, select "Make: Generic", and the appropriate Model for your vehicle's powertrain. This selection will choose the format of your report.
- 2) Click Setup->C5 to view your loggers. Edit the logger you are working with and link it to the vehicle that you created in the previous step. Do not select an update package.

Generate a Report via Manual Upload:

- 1) Set up your dbc file to interface to the portal using the FleetCarma dbc naming and unit convention rules (see the "DBC Setup for FleetCarma Integration" section). There should be one dbc for each CAN channel. Decode your local data with this dbc on your PC to ensure data is decoding properly.
- 2) Upload the dbc to the portal under Admin->DBC List. Choose the parser appropriate for your powertrain type. This parser is used to identify the appropriate energy/fuel calculations to apply in the generation of the report. FleetCarma will generate and provide you with a random 25 hex-digit unique identifier for each of your dbc files.
- 3) Update your local copy of the logging configuration file (.CCF) with the 25 digit unique identifier. The C5 will propagate this ID into the log files (.BIN) and will inform FleetCarma which dbc to use to decode your data.
- 4) Log some new data and upload this new data to your vehicle under Upload->C5. Once this is done, you should be able to view a valid report. Ensure the data in your report looks correct. If there appears to be issues, revisit your dbc file, or contact support@fleetcarma.com for technical support.

Upload Data Wirelessly:

- 1) Configure your wireless system by generating a wireless config file (.CCW) and placing it on the SD card in the root directory.
- 2) Generate this file via the Admin->Loggers->Wireless Configuration Profiles tab. Choose a suitable name for the profile. Port 80 or 1882 may be selected depending on your internet firewall settings (if unsure, port 80 is recommended preferentially). The Server Address **must** be www.fleetcarma.com. Depending on your provider, traffic on port 80 may be proxied and manipulated by your wireless ISP in a manner not compatible with FleetCarma (T-mobile in particular is known to have issues in this regard). In this case, port 1880 may be used to skirt this interference.
- 3) If you have a wifi C5, you may input up to 5 wifi credentials. The C5 will sequentially attempt to connect to any of those available networks until it either gets connected to FleetCarma, or finds no more suitable networks to try.
- 4) If you have a GSM C5, you must enter the correct APN for your wireless network provider (which may be found online). The Band is also carrier-specific: In North America, this **must** be GSM850Mhz_PCS1900Mhz. Contact Support@fleetcarma.com for help in selecting appropriate values.
- 5) GPS logging is available only to GSM C5's. The logging rate for the GPS system may also be specified here. If the value of this box is either empty or set to 0, GPS logging will be disabled.
- 6) Save the profile, download the file, and place it in the root directory of the SD card. Power cycle the logger and ensure no CAN data is present. If there is appropriate network connectivity, the device will 'check-in' with FleetCarma.com. The wireless search process may take a few minutes. When it is complete, the device will go to sleep. Verify connectivity on the Setup->C5 tab. The last Check-in should be updated. If there are files on the card, they will be uploaded to the portal.
- 7) Your wireless logger is now fully functional.

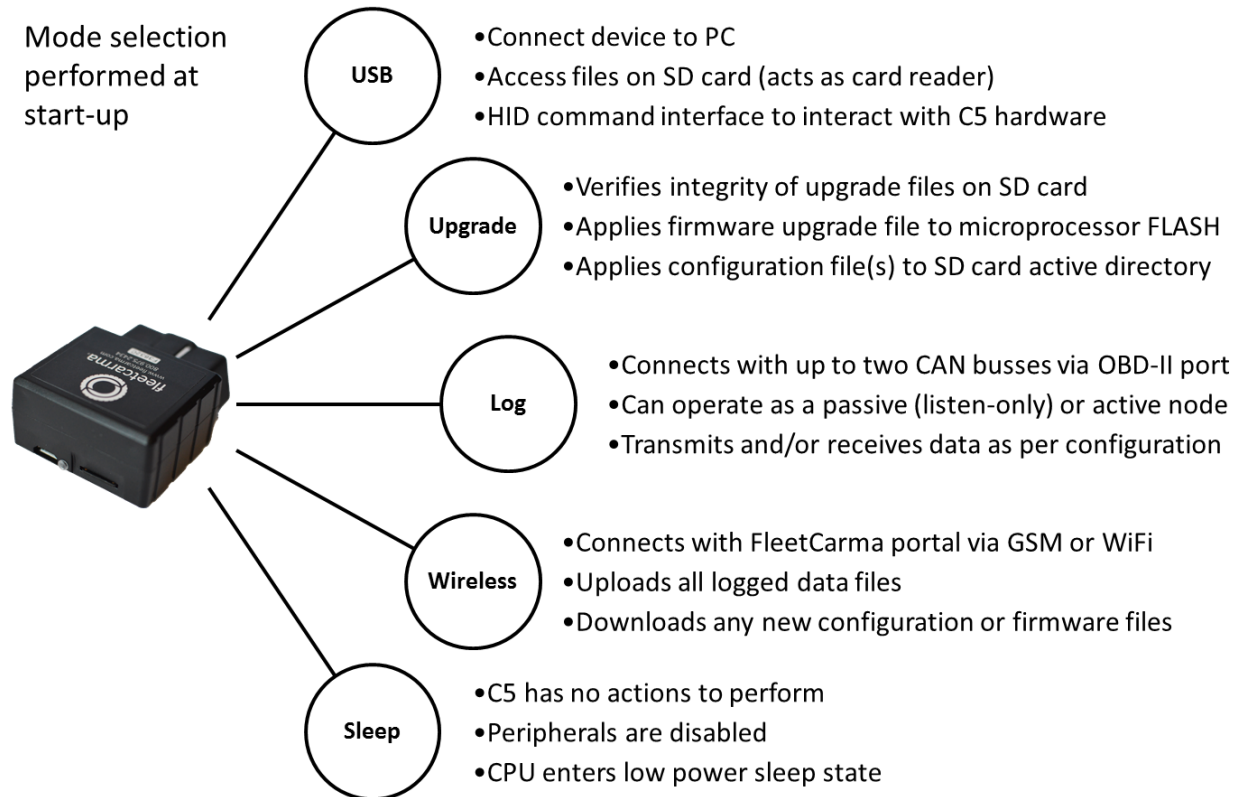
Over-the-air updates

Over the air updates can occur via update packages. These are a set of files that are packaged together and sent to the C5 wirelessly directly from FleetCarma. They can be firmware upgrades (.HEX), new logging configuration files (.CCF), or new wireless configuration files (.CCW). To send an update package:

- 1) Click on Setup->C5->Update Packages->Create Update Package. Name the package appropriately and select the files you wish to send to the logger. This creates a package in the portal.
- 2) Then click on Setup->C5 and edit the logger you wish to update. Select the update package you just created, and save changes. The next time the logger checks in, it will download this package and update itself. You can view the status of this operation on the "Manage your Loggers" page.

Once the entire package has been received, the C5 will apply any firmware upgrades, and replace the existing CCF and CCW files with any new ones and then reboot. This upgrade process will pre-empt any other wireless or logging tasks and as a result some data loss may occur during this period. Also note that if upgrade CCW is misconfigured, this can lead to loss of communication and manual replacement of the CCW file on the SD card will be required.

C5 Moding and Logging Behaviour



The above figure illustrates the moding sequence within the C5. They are listed in priority order starting at the top. Upon power up, the C5 will, in order, check for:

- 1) Connection to USB. If detected, it will mount the SD card as a mass storage device
- 2) If there are upgrade packages to apply, these are done and the system rebooted
- 3) If there is CAN traffic present or the voltage wake trigger is active, the system will enter logging mode until there is no more CAN traffic present or the voltage sleep trigger is active.
- 4) Once Logging mode has exited (typically this happens at key down), the C5 will enter wireless mode to upload its data.

- 5) Once wireless mode has completed (successfully or timed-out), the C5 will enter low power mode. In this mode it will wake either upon CAN traffic or once an hour, on the hour, to check-in with FleetCarma.com.

Voltage Wake System

The voltage wake system may also be used in applications where GPS or voltage logging is required while the input voltage is greater than some threshold and/or CANbus is not available. An example of this would be GPS and voltage logging on an ICE vehicle without access to the CANbus.

Antenna Placement

Both the Wifi C5 and the GSM C5 are typically supplied with leaded antennas as the placement of an antenna on the dashboard of a vehicle will significantly improve the wireless range vs. the under-dash location. The GSM antenna is designed to be mounted flat on the dashboard surface with double-sided tape, preferentially in the center of the windshield. The wifi antenna is designed to be adhered directly to the windshield. This is typically done by the drivers A-pillar low on the windshield.

Other antenna options are available from CrossChasm.

Status LEDs

The C5 has a tri-colour LED that can be used to indicate the operation of the system. The LED can be disabled from the Logging Configuration software. If the LED is selected to be disabled, it will still always turn on for the first 30 seconds of logger operation before extinguishing. If the LED is selected to be enabled, the LEDs will stay active while the logger is awake. During initial setup it can be useful to identify what the C5 is doing by enabling the LED system; if this is done, and the LEDs are not blinking, the system can be assumed to be asleep. It is typical to disable the LEDs once the system is commissioned in order to reduce driver distraction.

It is important to note that any critical fault that prevents logging functionality will result in a red light. If this occurs, the logger is not functioning properly and must be diagnosed; the root directory of the SD card will have a file called "Status.txt". This file will have the fault information and corrective actions printed in ascii text format. The red light will never alight unless there is a critical fault preventing system operation. It is not true that the lack of a red light implies desired operation. Incorrect wireless operation or configuration will not typically result in a red light.

LED Sequence	Logger Status	Implication
Green LED blinking once per second	Running in Logger Mode, No Loggable CAN traffic	The C5 is in logging mode, either waiting for loggable CAN traffic, waiting for the vehicle to stop broadcasting CAN traffic, or it is using the voltage wake-up system to log GPS, input voltage, and temperature.
Green LED blinking once per second Blue LED blinking (no specific pattern)	Running in Logger Mode, Logging CAN traffic	The C5 is in logging mode and is logging at least some CAN traffic on all CAN busses where traffic is expected (but not necessarily all messages the logger is configured to listen for).
Blue LED blinking once per second	Running in Upload Mode	The logger is in upload mode, which consists of initializing the wireless hardware, connecting to a wireless network, opening a connection to FleetCarma, and uploading data. The LED sequence does not reflect which of these actions is currently in progress, only that upload mode as a whole is currently running.
Blue LED blinks once every 8 seconds	Sleep Mode	The logger is in sleep mode. It is waiting for a trigger to wake up and begin logging or uploading. These triggers depend on the logger configuration, but typically include: <ul style="list-style-type: none">• Input voltage exceeds wake-up threshold (if voltage wake-up feature is enabled)• CAN traffic is detected on an enabled CAN bus• The hour rolls over and it is time to check-in with the FleetCarma server

DBC Setup for FleetCarma Integration

In order to create a report to view in FleetCarma, there are some mandatory requirements for dbc file setup. This setup is not necessary to decode data locally on a PC, and there are no limits on what signals or what size the dbc is. In order to download data, you will need to generate a valid report. The absolute minimum set of data required to generate a report is vehicle speed. You may also make use of the more advanced features like alerts, fuel economy, and charging, trip data, and vehicle usage by adding the necessary signals to your dbc.

There is a framework dbc file containing all these signals available for download: [Here](#). All signals used in the FleetCarma system are included in this dbc. You may use this dbc as a starting point and configure it for your vehicle. Note that not all signals need to reside on the same CANbus. You should also delete all signals not being populated by your vehicle.

FleetCarma looks to the signal name to find the pertinent data, and so it is important that the name is correct (capitalization not important) in your dbc file, and that the units are as specified below. If you have signals that are not applicable to your powertrain, it is important to remove those signals from your dbc.

Signal Name	Powertrain Type	Units	Description
veh_speed	ALL	KPH	Required for Distance/Fuel economy, idling calculations
maf	ICE/HEV/PHEV	grams/sec	Required for fuel calculation. If only fuel rate is available, this will need to be calibrated to a MAF-equivalent for gasoline using a 14.6 ratio.
hvbatt_current	PHEV/BEV	Amps	Used to deduce charging/driving cycles and calculate charging/driving energy. Positive values correspond to charging the battery.
hvbatt_voltage	PHEV/BEV	Volts	Used to deduce charging/driving cycles and calculate charging/driving energy
outside_air_temp	All	DegC	Used for display only
charger_acvoltage	BEV/PHEV	Volts	Used to calculate charging efficiency
charger_accurent	BEV/PHEV	Amps	Used to calculate charging efficiency. Positive values correspond to charging the battery.

charger_power	BEV/PHEV	Watts	Alternative to charger_acvoltage & charger_accurent
DTC<N>	ALL	OBDII DTC	FleetCarma supports up to 10 at a time. Signal names should be <code>dtc1</code> , <code>dtc2</code> , ..., <code>dtc10</code> .
num_dtcs	ALL	integer	Number of valid DTC signals. For example, <code>num_dtcs = 2</code> means that <code>dtc1</code> and <code>dtc2</code> are valid but <code>dtc3+</code> are not.
engine_rpm	ICE/HEV/PHEV	rpm	Used with vehicle speed to determine idling

User Roles and Permissions

Your primary account on the FleetCarma website will automatically come with the following permissions:

- 1) Fleet Admin
- 2) Driver Behaviour Feedback
- 3) Engineering User
- 4) Alert Viewer
- 5) Fleet Summary Viewer

Being a Fleet User will allow this primary account to create new sub-accounts belonging to the same fleet, and to control the access permissions of those users.

The following table summarizes the features enabled by these different permission levels:

User Role	Description of Permissions
Fleet Admin	Provides “ownership” over the fleet vehicles in FleetCarma. Provides the ability to create new users within the fleet, to create new vehicles, to edit logger-vehicle linkages.
Driver Behaviour Feedback	Enables the Driver Feedback tab on a vehicle report. This allows estimation of driver-related metrics: Eco Driving, Average Acceleration/Deceleration, Idling Percentages
Engineering User	Enables access to engineering functions: DBC file features, Upgrade package capabilities, CCW configuration, PC software tools.
Alert Viewer	Enables the Alerts Tab on a vehicle report. This allows the viewing of OBD2 diagnostics trouble codes on your vehicles
Fleet Summary Viewer	View the Fleet-wide summary for your fleet on the Reports Tab. Provides Drill-down summary data across your fleet filtered by date/vehicle types

To create other users for your organization: Click on Admin->Users->Create New User. Enter their information and select their User Roles and ‘Save Changes’. For ‘read-only’ users who can only view reports: deselect all User Roles.

CrossChasm C5 CANbus Logger Hardware Spec Sheet

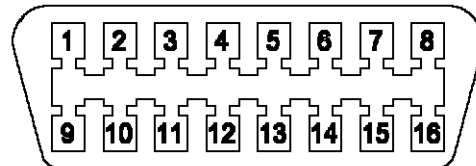
FEATURES

- MicroChip PIC32MX795F512H (80 Mhz)
- 2 CAN Channels
- 9-30 VDC Voltage range
- Low current consumption
- Micro USB Connector
- Onboard Thermistor
- Micro SD Card bay
- Red-blue-Green LED
- 12V Voltage sensing
- MCP7941 battery-backed real time clock with alarming
- CANbus Transceiver low power mode

APPLICATIONS

- Long term embedded CANbus logging
- Prototype vehicle monitoring
- Automated data collection and analysis

OBD2 Pin-outs

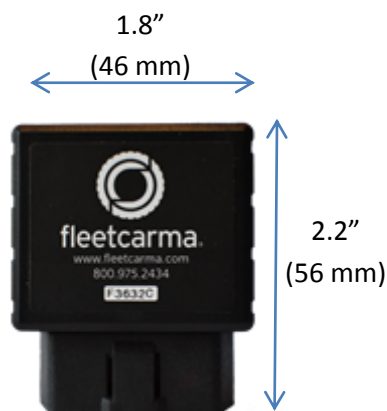


Female (Vehicle-side) Connector Shown

Function	Pin
Power (Battery) (must be always on)	16
Ground	5
CANbus 1 Low	14
CANbus 1 High	6
CANbus 2 Low	12
CANbus 2 High	13

For more information, please contact:

support@crosschasm.com



802.11 Wifi
Variant



GSM/GPS
Variant